HYBRID VEHICLE TURBINE ENGINE
SUPPORTING TECHNOLOGIES R&D PROGRAM AND PLANS
(A.K.A. GAS TURBINE HYBRID POWER UNIT R&D)

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OVERVIEW

For many years, the DOE Office of Transportation Technologies supported the development of advanced ceramic technology needed for high efficiency, low polluting, automotive gas turbine engines. The current goal of the program is to develop a high efficiency, ultra low-emission, multi-fuel capable gas turbine hybrid power unit (GT-HPU) for application in hybrid vehicles with over 3X the fuel efficiency of today's mid-size automobiles. Specific objectives are to develop and validate advanced gas turbine technology for application in 1) hybrid test vehicles that achieve 50 mpg and meet EPA Tier II requirements by 1998; 2) hybrid test vehicles that achieve 80 mpg and meet EPA Tier II requirements by 2004; and 3) hybrid test vehicles that achieve greater than 80 mpg and meet more stringent emission levels than EPA Tier II by 2006.

EVOLVING PROGRAM ORGANIZATION AND PLANS

Overall gas turbine program activities are now the responsibility of the Office of Advanced Automotive Technologies (OAAT) and are implemented in close coordination among three teams: Advanced Heat Engines, Advanced Automotive Materials and Vehicle Systems. In cooperation with the United States Council for Automotive Research (USCAR), OAAT is preparing to re-direct and focus current efforts aimed at the 2X (50 mpg) vehicle to also address the requirements of a gas turbine HPU for the 3X (80 mpg) vehicle. The technology R&D and the future design, development and vehicle evaluation of the complete GT-HPU will be conducted by industry teams. Additional enabling R&D will be conducted at national laboratories, universities, and other research laboratories, especially in the areas of combustion/emissions and engine system materials/component manufacturing.

TECHNICAL BARRIERS

Using readily available test rigs and engine test beds, the program is concentrating R&D efforts on critical technology barriers: 1) low part load efficiency, 2) high manufacturing cost, 3) unproven durability and reliability, and 4) unproven emissions.

To improve part-load efficiency, the program is developing reliable structural ceramic materials to permit turbine inlet temperatures at least to 2,500F; small, high efficiency compressor and turbine components; low friction, non-oil lubricated bearing system; cost effective materials/processes for insulation systems with improved thermal and erosion characteristics; and high temperature heat recovery systems (regenerators and recuperators) with low leakage seals.

To reduce manufacturing cost, the program is targeting improved ceramic component fabrication including reduced starting powder cost, improved forming techniques to increase yields and dimensional accuracy,

improved densification processes, cost effective bonding of ceramic/ceramic/metal materials, and reduced machining times and damage. Efforts will develop engine designs with minimum superalloy content; design for automotive manufacturing/assembly requirements; and cost effective, in-process, non-destructive evaluation (NDE) techniques.

To improve durability and reliability, the program is developing high temperature ceramic materials that withstand 3,500+ hours of exposure to thermal and mechanical stress at turbine inlet temperatures up to 2,500F; simple, robust turbine assemblies; durable regenerator disks and seals; and efficient aerodynamic components in small (thin) sizes.

To improve emissions, the program is addressing cold start transient emissions; homogeneous/lean mixture preparation without flashback during transients; high temperature capable combustor matrices; and alternative/multi-fuel combustion emissions.

FUNDING

The (previously planned) overall gas turbine activity funding level for FY1997 is approximately $18.7 million. This includes $7.6 million, $5.0 million, and $6.1 million for turbine hybrid power units, component technology support, and materials, respectively.